

Across Central America. By J. W. Boddam Whetham.
(London : Hurst and Blackett, 1877.)

THIS is a thoroughly readable and exceedingly instructive narrative, by a capable observer, of a journey through a country not often visited by travellers, and of which English readers probably know little or nothing. Mr. Whetham gives an interesting account of some of the wonderful ruins which exist in Central America, and we can commend his work to our readers as possessing both novelty and interest.

LETTERS TO THE EDITOR

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[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]*

The Contractile Filaments of the Teasel

THE observations of my son Francis on the contractile filaments protruded from the glands of *Dipsacus*,¹ offer so new and remarkable a fact in the physiology of plants, that any confirmation of them is valuable. I hope therefore that you will publish the appended letter from Prof. Cohn, of Breslau, whom every one will allow to be one of the highest authorities in Europe on such a subject. Prof. Cohn's remarks were not intended for publication, but he has kindly allowed me to lay them before your readers.

Extract from Prof. Cohn's Letter:—

"Immediately after the receipt of your very kind letter of July 26 I went to fetch *Dipsacus*, several species of which grow in our Botanic Garden; and proceeding after your recommendations, I put transverse sections of the cup-like bases of young leaves, or the epidermis of these parts carefully removed from the green parenchyma, into distilled water. I thus had the pleasure of witnessing with my own eyes this most curious discovery. First I ascertained the anatomical structure of the pear-like glands which are rather elegant and remarkable. From the basal cell rises the stalk-cell, in the second story there are two cells, in the third four, and in the uppermost series eight cuneiform cells converging to the centre. But you may conceive how much I was surprised by seeing the filiform protuberances issuing from the apex of the glands; it was quite a perplexing spectacle. The filaments are, in their refrangibility, very like the pseudopodia of some Rhizopods (*e.g.*, *Arcella* or *Difflugia*). I followed their changes for some time, and remarked quite definitely, as I find described in the paper of Mr. Francis Darwin how the protuberances slowly lengthen out, crook themselves hooklike or winding, and get knobbed either at the summit or midway; I saw the knobs or beads glide down the thread, and at last be sucked into a globular mass adhering to the gland. I saw the protuberances always rise between the septa of two or more adjoining cells, but nearly as frequently between the lateral septa as on the apical centre. Generally there were many protuberances on the same gland, pressed forward out of different spots; sometimes I saw two diverging branches proceed from the same point like a pair of compasses, each behaving independently in its changes. But the most curious appearance in these protuberances was a constant waving undulation along their extension, sometimes slower and perceptible with difficulty, sometimes vigorous and quicker, but never ceasing; more delicate filaments appeared to me very like *Vibrio*, or the vibratory flagella of some Infusoria. Not finding a special description of the waving movements of the filaments in your son's paper, I asked some of my pupils if they saw anything remarkable in the filaments, without indicating what, but they all took the same impression as myself. The only facts I have not yet been able to witness of your son's discoveries are Figs. 6, 14, 15, and the moniliform contraction; nor have I yet found time to apply chemical reagents, of which your son has made such good use.

"Of course I am not able, after two days' inspection, to form

¹ Abstract published in *Proc. Roy. Soc.*, 1877, No. 179; published in full in *Quarterly Journal of Microscopical Science*, July, 1877.

a definite judgment about the true nature of the filiform protuberances. Putting aside the hypothesis of a parasitic Rhizopod, there are two probabilities which still balance in my mind, as clearly stated by your son. (1) The protuberances are secretions of some colloidal matter, absorbing water, but insoluble in it; the movements are physical (not vital ones), the elongation of the filaments depending upon the imbibition, their contraction on the withdrawal of water by different reagents. There are such substances, *e.g.*, *myeline*, which shows rather similar changes in water. Please also to repeat the experiments I performed at the meeting of the British Association last year. Into a cylindrical glass containing soluble silicate of alkali (*Wasserglas*), diluted with half its amount of water, put a small piece of crystallised chloride of iron; from the fragment there rises a hollow reddish tube growing upwards and moving very quickly, like an Enteromorpha. But if you put into the diluted silicate some *protochloride* of iron (the latter is usually in the form of a powder, but may easily be brought by gentle pressure of the fingers into crumb-like masses), then from the lumps there arise innumerable filaments, very delicate and transparent, very like the glass threads of *Hyalonema*, which rise in fascicles vertically till they reach the surface of the fluid.

"But I cannot deny that the general impression produced by *Dipsacus* does not contradict the hypothesis that the changes of the filaments are the vital phenomena of protoplasmic pseudopodia.

"A French biologist (whose name I cannot just now remember) has proved many years ago (I think in an early number of the *Bull. de la Soc. Bot. de France*) that the water in the cups of *Dipsacus* is not a simple collection of rain in a gutter, but a secretion of the leaf bases. If this be truly the case, it is quite probable that the glands may have a special adaptation for this purpose. Indeed, I should not hesitate to agree with the vital theory, if there were any analogy known in plants. But further study of the phenomenon and the repetition of the chemical reactions which your son has already indicated, will, I hope, in a short time enable me to form a more decided judgment in this perplexing dilemma.

"In the meantime I am happy to congratulate Mr. Francis Darwin and yourself on account of the extraordinary discovery he has made, and the truly scientific paper in which he has elaborated it, and which has added a series of quite unexpected facts to the physiology of plants."

In a subsequent letter, Prof. Cohn describes what appear to him as thinned points or pores in the cell wall of the glands from which the filaments seem to be protruded. He also mentions the very curious fact which he has discovered, that by adding iodine to the detached epidermis of the leaf cups of *Dipsacus* the whole fluid contents of the epidermis cells turn blue like diluted starch paste, although no starch grains are met with in any epidermis cell except in the stomata.¹ He adds that the basal cell of the gland becomes blue, while the rest of it and the excreted globules are stained yellow.

I may add that I have heard from Prof. Hoffmann, of Giessen, that he formerly observed contractile filament of a somewhat similar nature on the annulus of *Agaricus muscarius*. He has described them in the *Botanische Zeitung*, 1853, and figured them, *ibid.*, 1859, tab. xi. Fig. 17.

CHARLES DARWIN

Down, Beckenham, August 15

Relations between Sun and Earth

PROF. BALFOUR STEWART in the last of his exceedingly interesting articles in *NATURE* (vol. xvi. p. 45) on the suspected relations between the sun and the earth, winds up with an appeal (which I should like to see promptly responded to by the Government here as well as at home) in favour of the establishment of some institution to keep a daily watch upon the luminary that is found to exercise such a marvellous control over terrestrial magnetism and meteorology. He also mentions incidentally the discovery by Dr. Hunter that the famines in Southern India have a period of recurrence which is nearly the same as that of sun-spot frequency. This is no doubt an exceedingly plausible hypothesis inasmuch as five out of the six years of drought mentioned by Dr. Hunter as preceding the years of famine

¹ Prof. Cohn adds that the blue coloration of the epidermis by iodine occurs in the leaves of *Ornithogalum*.

during the present century fall within the group of minimum sun-spot years, the sixth (1854) being also a year of relatively few sun-spots (192 according to Wolf).

Dr. Hunter's avowed object, however, in writing his pamphlet was to prove that a cycle of drought sufficient to cause famine existed throughout the *whole* of Southern India, and with this end in view he has been content to show that a cycle of rainfall corresponding with the period of solar maculation existed merely for one single station, viz., Madras.

Having found a decided correspondence between the rainfall of Madras and the eleven-year period of sun-spots, he thence argues somewhat hastily that the same conditions apply throughout the whole of Southern India. This hasty generalisation from the results of one station situated in a vast continent, the rainfall of which varies completely both in amount and the season in which it falls, according to locality, has been strongly contested by Mr. Blanford, the Government meteorologist, who on making a careful comparison of the rainfalls of seven stations, three of which—Madras, Bangalore, and Mysore—are in Southern India, the others being Bombay, Nagpore, Jubbulpore, and Calcutta, finds that with the exception of Nagpore in Central India, which shows some slight approach to the same cyclical variation which is so distinctly marked in the Madras registers, the rest of the stations form complete exceptions to the rule adduced for Madras, in many of them the hypothetical order of relation being reversed. Mr. Blanford, however, shows that underlying the above irregularities a certain cyclical variation exists on the average at all the stations, the amount nevertheless being so insignificant (not more than 9 per cent. of the total falls) that it could not possibly be considered of sufficient magnitude to become a direct factor in the production of famine. It thus appears that the cycle of rainfall which is considered to be the most important element in causing periodic famines, has only been proved satisfactorily for the town of Madras. It may perhaps hold for the Carnatic and Northern Siccars—the country immediately surrounding Madras, though, owing perhaps to the want of rainfall registers in these districts, evidence with regard to this point is still wanting.

Though Dr. Hunter has thus been only partially successful, I would not attempt to detract in any way from the value of his able pamphlet, so far as it goes, an indirect effect of which has been to stimulate meteorological inquiry and research in the same direction throughout India. The meteorology of this country, from its peculiar and tropical position, is in such complete unison with any changes that may arise from oscillations in the amount of solar radiation and their effects upon the velocity and direction of the vapour-bearing winds, that a careful study of it cannot fail to discover meteorological periodicities in close connection with corresponding periods of solar disturbance. In connection with the previous remarks, and as showing what a close connection exists between solar and terrestrial meteorology, I may observe that Mr. Hill, the meteorologist for the North-West Provinces, and myself, have coincidentally discovered the existence of a remarkable cycle in the winter rainfall of Northern India, between the latitudes of 20° and 30° , corresponding inversely with the period of solar spots, i.e., the maximum winter rainfall coincides with the minimum period of sun-spots, and vice versa.

As a failure of the winter rains in the Northern Provinces in 1860-61 (*years of maximum sun-spot*) has been the cause of a severe famine, this theory, if completely established, would not be without its value in the economical administration of the North-West Provinces and the Punjab. I have not at present examined the rainfalls of all the stations in the Upper Provinces, but Mr. Hill, having readier access to them than myself, has probably done so to a larger extent, and tells me that the results of his investigations are similar to my own in bearing out the preceding hypothesis. A theory is not wanting to account for this tendency to vary inversely with the sun-spots, if we, according to opinion held by Drs. Hahn and Köppen, Prof. Piazzi Smyth, and Mr. Pogson, the Government astronomer at Madras, assume that the sun's heat is greater in years of minimum sun-spot. For in these years the anti-trade current, the descent of which upon the Himalaya and Northern India in the winter is generally understood to be the vehicle of the rain at that season, would be owing to the increased evaporation over the Southern Indian Ocean, reinforced with a larger supply of vapour than usual, while in years of maximum sun-spot the supply would be smaller. At all events, whatever be the real cause, the facts as far as we have gone, are exceedingly favourable to the existence of such a cycle. Calcutta, though lying close to

the tropics, and therefore coming in for a small share of winter rainfall, still shows the preceding relation to a wonderful extent, and as its register of rainfall extends farther back than most of the other North Indian rainfalls, furnishes a more trustworthy result than many other stations whose rainfalls registered only for short periods scarcely afford more than a slight balance of probability in favour of the assumption. The following table is arranged in a double series of years occupying the same position in the spot-cycle, and gives the average rainfall for each double series for the months of November, December, January, February, March, and April, from 1837 to 1876 inclusive. I have indicated the groups containing the years of maximum and minimum sun-spot. The maximum rainfall will be seen to occur in the latter, and the minimum in the former group.

Calcutta Rainfall during the months of November, December, January, February, March, and April.

Years.	Average rainfall of group in inches.
11th 1876 1865 1854 1843 } Group containing years of minimum sun-spot.	8.49
1st 1877 1866 1855 1844 }	6.44
2nd 1867 1856 1845 }	
3rd 1868 1857 1846 }	5.93
4th 1869 1858 1847 }	
5th 1870 1859 1848 1837 } Group containing years of maximum sun-spot.	4.44
6th 1871 1860 1849 1838 }	
7th 1872 1861 1850 1839 }	5.03
8th 1873 1862 1851 1840 }	
9th 1874 1863 1852 1841 }	6.15
10th 1875 1864 1853 1842 }	
Eleventh series repeated	8.49

Further analysis only tends to render the connection still more evident, but I have no time to add anything further. In conclusion I need only remark that Jerusalem, which is situated somewhere about the same latitude as Lahore, and receives its total annual supply during the winter months alone, fully bears out the hypothesis as far as records show from 1846 to 1859.

Bankipore, Patna

E. D. ARCHIBALD

Reproduction by Conjugation

IN Prof. Allen Thomson's Inaugural Address to the British Association, I find the following sentence, referring to the simplest form of sexual reproduction among cryptogams, known as conjugation:—"In more ordinary cases, as in *Spirgyra*, where the embryo is formed in one of the two cells, it seems to be indifferent in which of them it is formed." If my own experience may be taken as trustworthy and adequate, there is one fact in connection with this phenomenon which would seem to show that it may not be altogether indifferent, and that the differentiation of male and female elements may be carried back even one step further than is stated by this distinguished biologist. When two filaments—which we may call A and B—are conjugating, then, as far as my observation has gone, the direction of conjugation is uniformly the same, i.e., either the contents of every cell in A pass over into the adjacent cell of B, or the reverse; we never find the contents of some of the cells of A passing over into B, and the contents of some of the cells of B passing over into A. If this is so, and if we call the filament in which the zygospores are ultimately produced A, then it is clear that we may fairly call A the female and B the male filament; and it would appear certain that there must be some hitherto undetected difference between them. My own observations in this respect relate almost exclusively to *Spirgyra*, and I shall be very glad to know if they are confirmed, or otherwise, by those of more experienced algologists.

ALFRED W. BENNETT

The Greenland Foehn

HOFFMEYER'S facts respecting spells of warm weather in the Arctic winter, as reported in NATURE, vol. xvi. p. 294, are very interesting, but his explanation of them seems demonstrably insufficient. He thinks they are a phenomenon of the same kind with the *Foehn* of the Alps, which latter he explains by saying that a wind which at its origin is saturated with moisture will, when it is forced over a mountain chain, be raised 1° Cent. for